BIOLOGY OF *OCHROGASTER LUNIFER* HERRICH-SCHAEFFER (LEPIDOPTERA: THAUMETOPOEIDAE), A DEFOLIATOR OF *ACACIA ACUMINATA* BENTHAM, IN THE WESTERN AUSTRALIAN WHEATBELT

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Abstract

Ochrogaster lunifer is a serious defoliator of *Acacia acuminata* in the Western Australian wheatbelt, and also of several other Acacia spp. across the southern half of Australia. This paper describes its life cycle in the south of Western Australia. It is univoltine with six larval instars occurring from January to June, and adults in November and December. Larvae are gregarious feeders and live together in a bag made of frass and cast skins covered with silk.

Introduction

O. lunifer, or bag-shelter moth, has previously been referred to as *O. contraria* Walker, or *Teara contraria* Walker (Froggatt 1923, Mills 1951, 1952, Jenkins 1962, Common 1970, McFarland 1979). Although the adults exhibit extremely variable colour patterns, the larvae are virtually indistinguishable so the species, or 'complex of species', is generally now referred to as *O. lunifer* (E.S. Nielsen and I.F.B. Common pers. comm.).

The moth is distributed from southern Queensland (Turner 1921), New South Wales (Froggatt 1923), South Australia (McFarland 1979) to Western Australia (Mills 1951, 1952; Van Schagen *et al.* in press). Common (1990) suggests that *O. lunifer* should be restricted to eastern populations but indicates that the species is undergoing taxonomic revision. Its larvae feed mainly on *Acacia* spp., such as *A. pendula, A aneura* and *A. acuminata*, but also attack eucalypts.

This paper gives an account of the life cycle and biology of *O. lunifer* during 1987 and 1988 in Durokoppin Nature Reserve, 25 km north of Kellerberrin, W.A. It is a pest of roadside *Acacia* species and the moths are believed to concentrate their attack on such trees as a result of their foliar nutrient levels being elevated by adjacent agricultural practices (Van Schagen *et al.* in press). Recently several reports have been received of bag-shelter moths causing severe damage to trees in N.S.W. (D.G. James pers. comm.) and in the northern wheatbelt of W.A. (I. Abbott pers. comm.).

Methods

Observations were made of the various stages in the life cycle of *O. lunifer* from November 1986 to December 1988. Six bag-shelters were collected per month during the larval stage and their contents examined in the laboratory. Larvae were counted, and measurements of head capsule width were recorded on 40 randomly selected specimens. These were later dissected to detect the presence of parasitoids.

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During the period of pupation, ten 1 m^2 areas of soil along a 100 m transect were excavated to a depth of 20 cm and the soil was sieved to extract any pupae. This was repeated at three locations where bag-shelters were abundant.

Adult activity was monitored daily by dawn counts of moths that were present on an illuminated glass window of a nearby farmhouse. Adults of this species have been deposited in the Australian National Insect Collection in Canberra.

Life History

In the study area, *O. lunifer* was univoltine (Fig. 1). Adults were present in November and early-December and females laid eggs on branches of *A. acuminata* during this period.

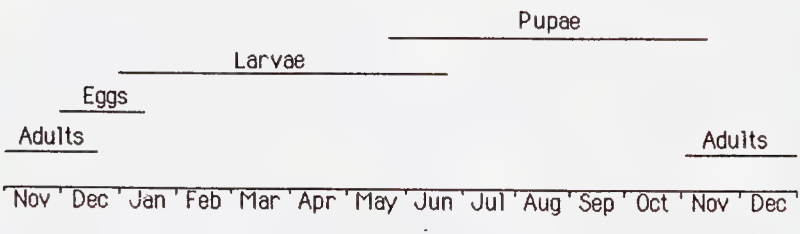

Fig. 1. Outline of the life cycle of *Ochrogaster lunifer* in the W.A. wheatbelt from November 1986 to December 1987.

Larvae emerged in late-December or early-January. Initially they were grey/brown but became reddish brown in later instars. Six instars were recorded (Fig. 2) with head capsule widths (means and standard deviations) of 0.57 ± 0.15 mm, 1.27 ± 0.12 mm, 2.06 ± 0.11 mm, 3.19 ± 0.15 mm, 3.92 ± 0.10 mm and 4.80 ± 0.10 mm respectively. In contrast to Dyar's Law which has a ratio of 1.4: 1, our results show a decreasing ratio from instar to instar. All instars were covered with dense hairs, which can be urticating to predators and humans. The larvae were always encountered in a communal nest, or bag-shelter, made of silk spun around frass and cast skins. Diameters of the bags ranged from about 20 mm in January to 225 mm in June, and varied greatly depending on the number of larvae present. Numbers of larvae per bag were highly variable. In January 1987, the average number of larvae per bag was 71 ± 32 (n=8) but this gradually declined to 16 ± 13 (n=8) during the 6th instar. The larvae are gregarious and feed mainly at night. They always left the bag-shelter in a single line, or procession (hence the name 'processionary caterpillar') to feed on foliage of *A. acuminata*. An estimate of the amount of foliage consumption by larvae has been reported elsewhere

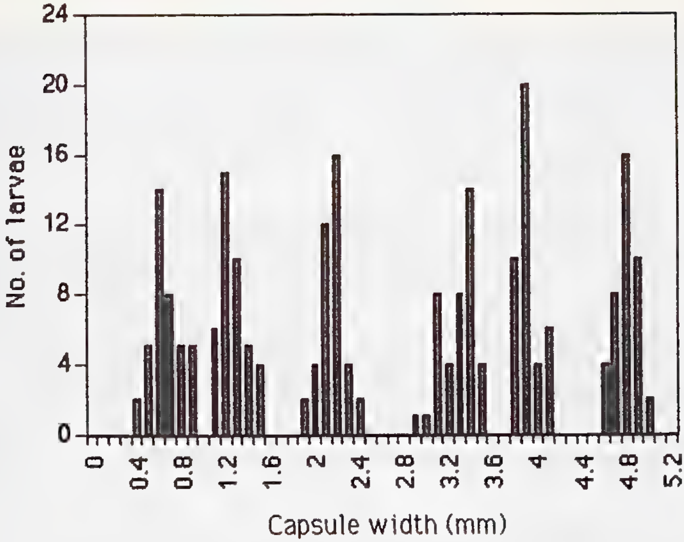

Fig. 2. Size distribution of larval head capsule width of *Ochrogaster lunifer*.

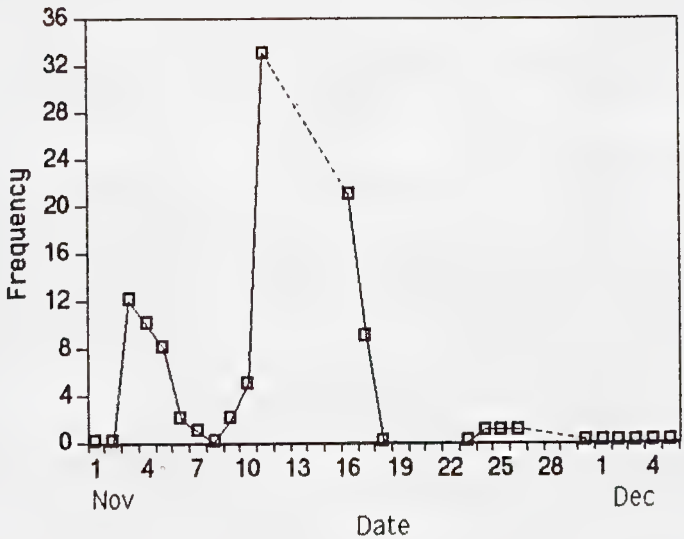

Fig. 3. Frequency of adult *Ochrogaster lunifer* captured during November and December 1987. The broken line represents a period when no recordings were made.

(Van Schagen *et al.* in press). It was found that, over its lifespan, the larvae in an average bag shelter consumed foliage equivalent to that on a 2 m tall *A. acuminata* tree. In the first year they found that larvae were most abundant on minor road verges, with an average of more than two bags per tree. In the second year, bag density dropped sharply to 0.16 bags per tree, the maximum number of bags on a tree was 16.

At the end of the larval stage, in late May or early June, the larvae moved down the trunk of the tree to pupate. Although several attempts were made to extract pupae from the soil none were located, so it is not known whether they pupate directly under the tree or disperse more widely. Adults emerged in November and were active until late December. Numbers of flying adults peaked around mid November (Fig. 3). Eggs were usually laid in clusters on branches of *A. acuminata* and were covered by protective scales. Bags collected in January 1987 contained an average of four unhatched eggs, suggesting that the total number of eggs laid in one batch by the female moth is 75.

Three colour forms of *O. lunifer* were found. One was light beige in colour, the forewings with a distinct white spot, abdomen barred orange and dark brown. The second was somewhat darker, its forewings also had the distinct white spot with a dark line parallel to the body across it, and abdomen striped light and dark brown. The third had white stripes on the forewings that radiated towards the wing tip, abdomen barred orange and dark brown. All three forms were similar in size with a wingspan of about 50 mm and all were confirmed as belonging to the *O. lunifer* 'complex of species' (E.S. Nielsen pers. comm.). Caterpillars of these three forms were similar in appearance.

Predators and parasites

No evidence of parasitism of larvae was detected. The unhatched eggs, which were collected in January, could have been parasitised. Some fifth and sixth instar larvae had small eggs attached to the head capsule. They are believed to be eggs of parasitic flies (Tachinidae, Diptera). Froggatt (1923) records *Titanoceros* sp. (Lepidoptera: Pyralidae), a moth predator of egg masses of the bag-shelter moth, and also a chalcid wasp parasite. In South Australia, spiders are known to predate small larvae before they have constructed bag-shelters (D. Morgan pers. comm.).

The adults could be predated by several insectivorous bird species, common, or moderately common, in woodlands in the Reserve (Dell 1978). Mackay (1985) states that bag-shelter moths are eaten by the pied butcher bird *Cracticus nigrogularis* (Gould), which was present in the study area.

The fact that the number of larvae decreased during progressive instars could be due to predation or parasitism, or to natural mortality. Although predation is a possibility, larvae are well protected by their urticating hairs and communal bag-shelter. It is unlikely that predation plays a major role in larval mortality. Parasitisation is unlikely to have a major influence, because no parasitoids were found except for the Tachinidae eggs on fifth and sixth instar larvae. The parasitoids mentioned by Froggatt (1923) are egg-parasites. An average of four dead eggs per bag is not a major mortality factor. Dehydration is not considered to play a major role, since the caterpillars forage at night and remain in the bag-shelter during the day-time; a strategy which would reduce their water loss. One possibility is that larvae die as a result of the lower nutrient levels in their food. This possibility has been investigated by Van Schagen *et al.* (in press).

Discussion

At present, there is some uncertainty about the taxonomic status of *O. lunifer*. In the south of Western Australia, it has a univoltine life cycle. The timing of the various stages of the life cycle corresponds with observations made in N.S.W. by Froggatt (1923), in S.A. by D. Morgan (pers. comm.) and by Mills (1951, 1952) in the W.A. wheatbelt. They indicate that the ecology of this species is similar throughout its range.

Several features of the biology *O. lunifer* indicate that there is a degree of social behaviour among the larvae. They construct large, conspicuous shelters of silk as permanent or semi-permanent gathering sites from which they set out to feed, leaving silk trails radiating from this resting site to the distant feeding sites on the host tree. Fitzgerald and Peterson (1988) refer to this type of foraging as 'central-place foraging'. No information is yet available on the relationship between groups of caterpillars where more than one bag occurs on the same host tree.

Acknowledgements

We thank Lyn Atkins for her assistance in the field and E.S. Nielsen for identification of the moths.

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